



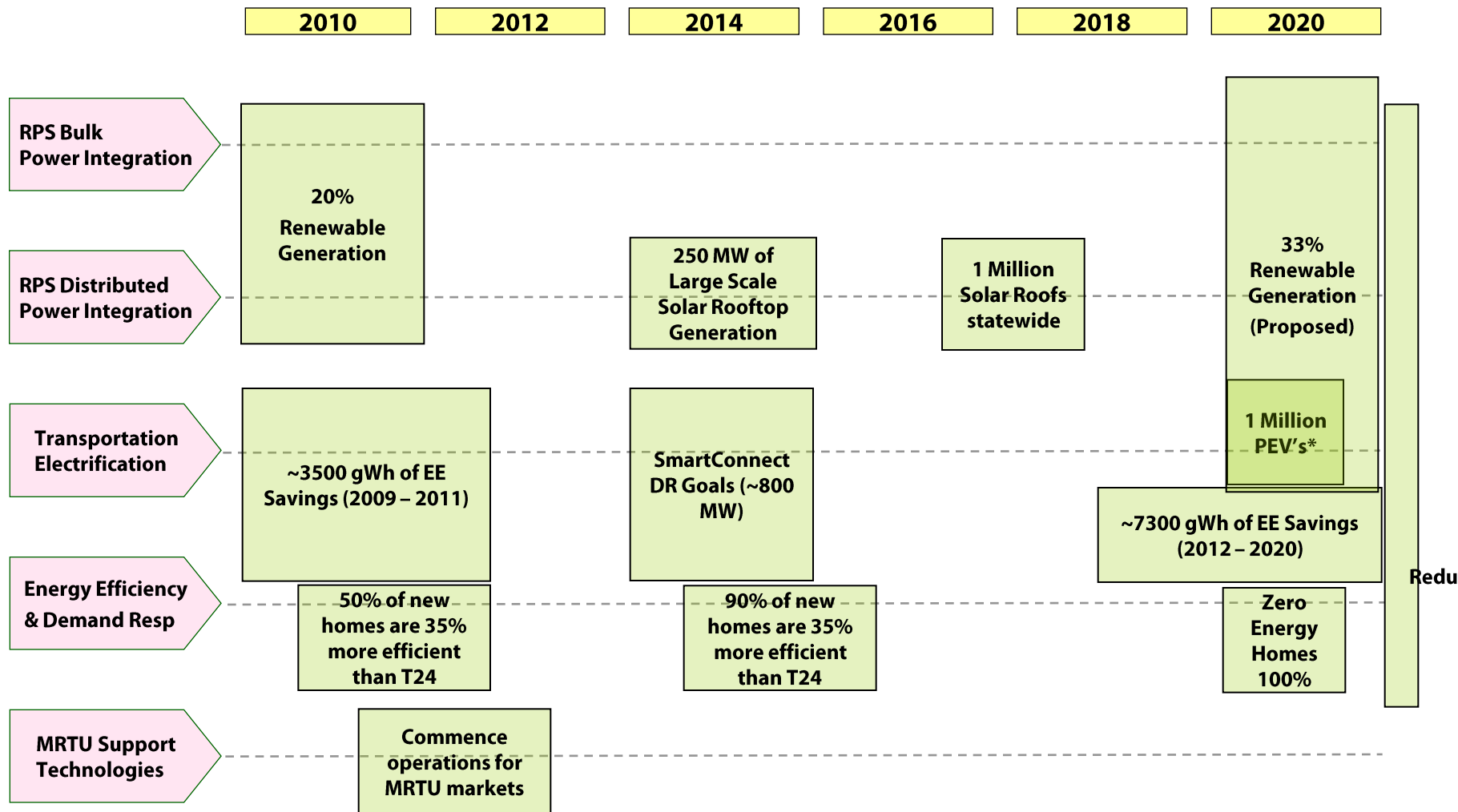
ADVANCED TECHNOLOGY
Transmission & Distribution Business Unit

SCE Smart Grid

**CPUC OIR 08-12-009
Workshop #3**

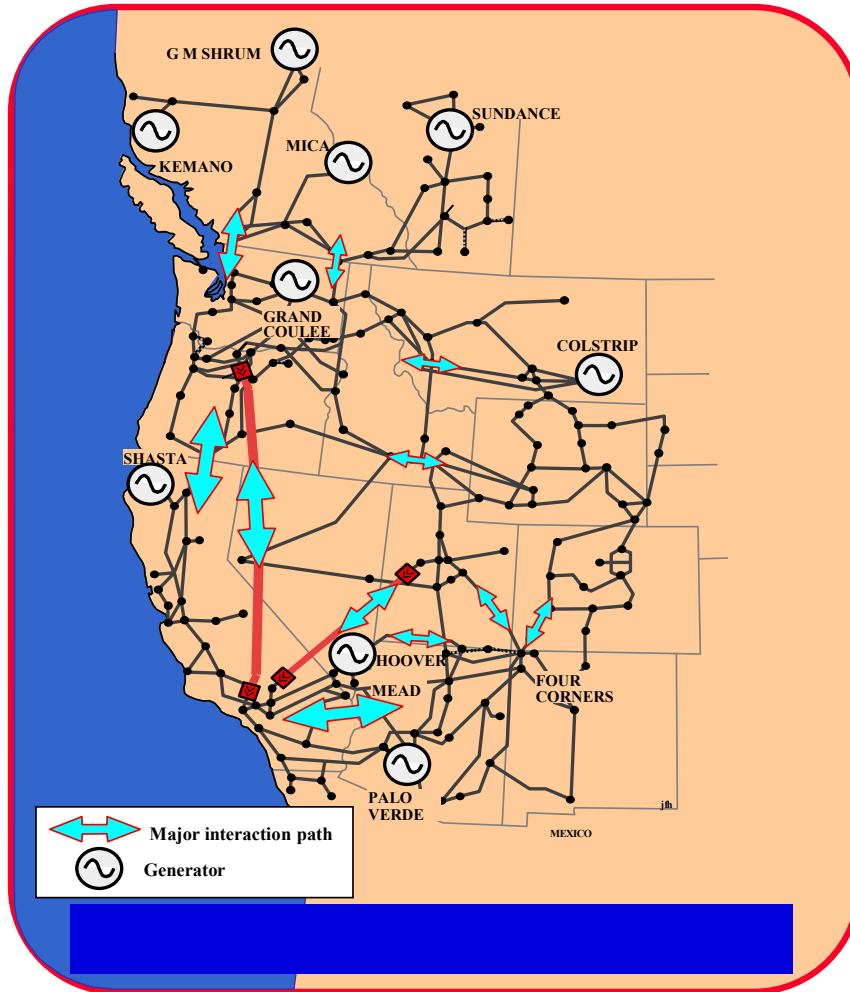
**Transmission
June 26, 2009**

Key Energy Policy Goals Mapped to Initiatives



* SCE estimate based on mainstreaming analysis
 ** Anticipated by SCE

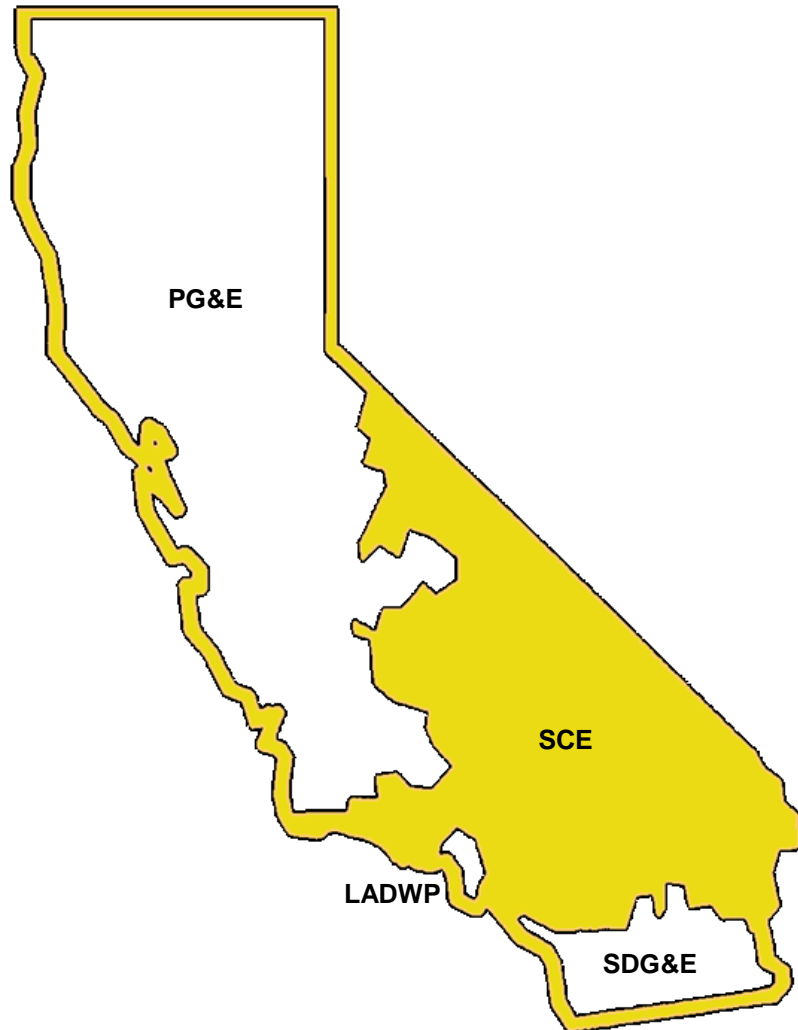
Western Electric Coordinating Counsel System



- WECC encompasses fourteen western US states, two Canadian provinces, and the northern portion of Baja California, Mexico
- About 160,000 MW generation and load
- Over 2,200 generators
- Extensive 500kV, 345kV, 230 kV and HVDC Transmission lines and network, 118K miles
- Transmission paths with high capacities and long lines

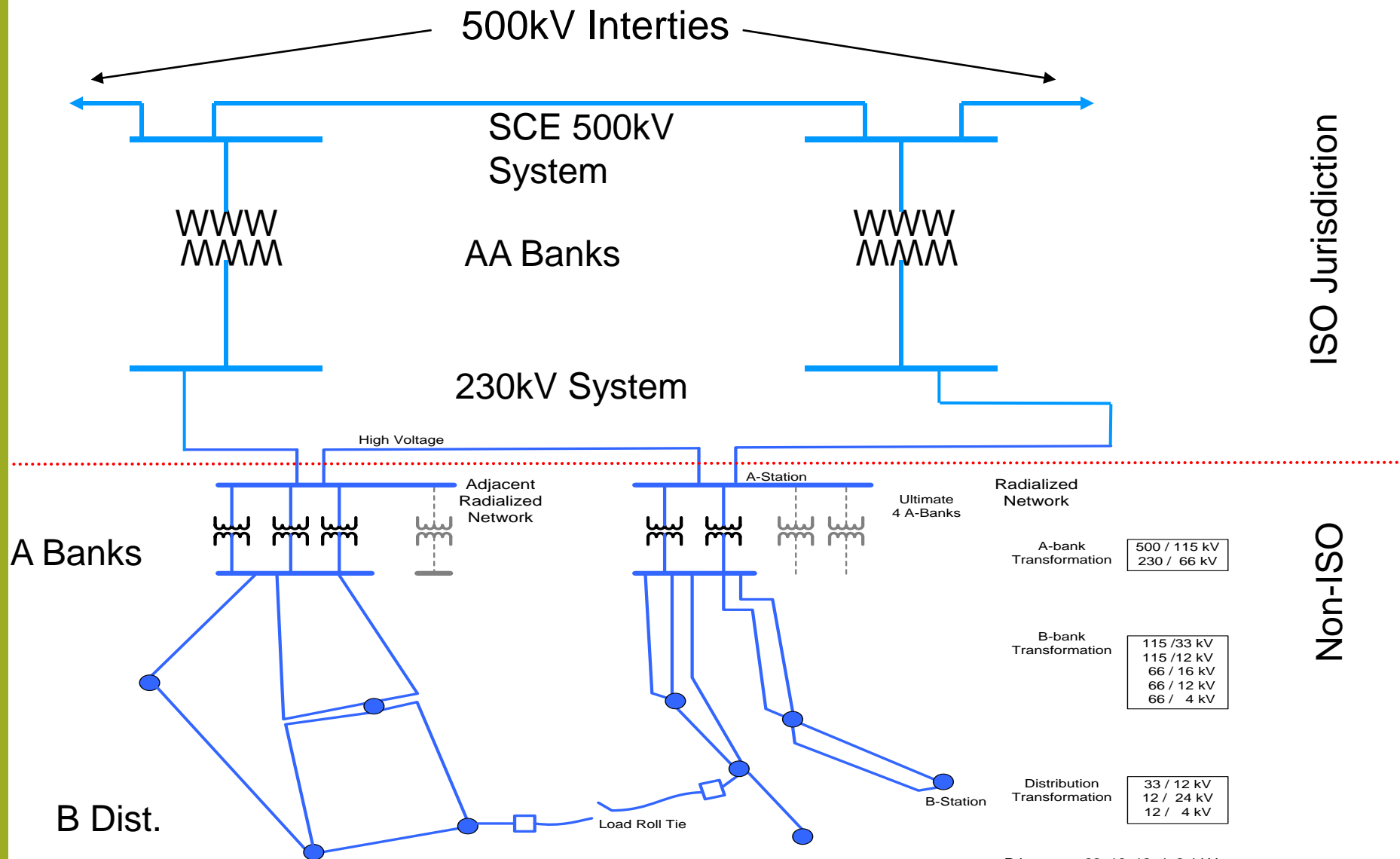
Southern California Edison

An Edison International Company



- Serve a population of 13 million people in a 50,000-square-mile service area within central, coastal and Southern California
- 12,000 circuit miles of transmission lines and more than 111,500 circuit miles of distribution lines
- 8 - 500/230kV substations
- 43 - 230/115 & 69kV substations
- 870 total substations including distribution
- Over 500 substations automated

SCE Transmission System



Wide Area Situational Awareness



- Monitoring static / dynamic phase angle limits (stress on the system)
 - Allows increasing loadings if margin is there
 - Alerts when reduced loading is necessary if the safe limits are exceeded
- Comparing phase angle measurements with benchmarked cases and keeping adequate dynamic margin
 - Avoid critical outages
 - Maintaining adequate margins if line outages occur and adjusting phase angles as necessary
- Monitoring oscillations
 - Oscillations contribute to system instability
 - Were a major factor in the 1996 Western Interconnect system disturbance
- Monitoring voltage support at intermediate locations when operating at large phase angles separations
- Event reconstruction and model validation

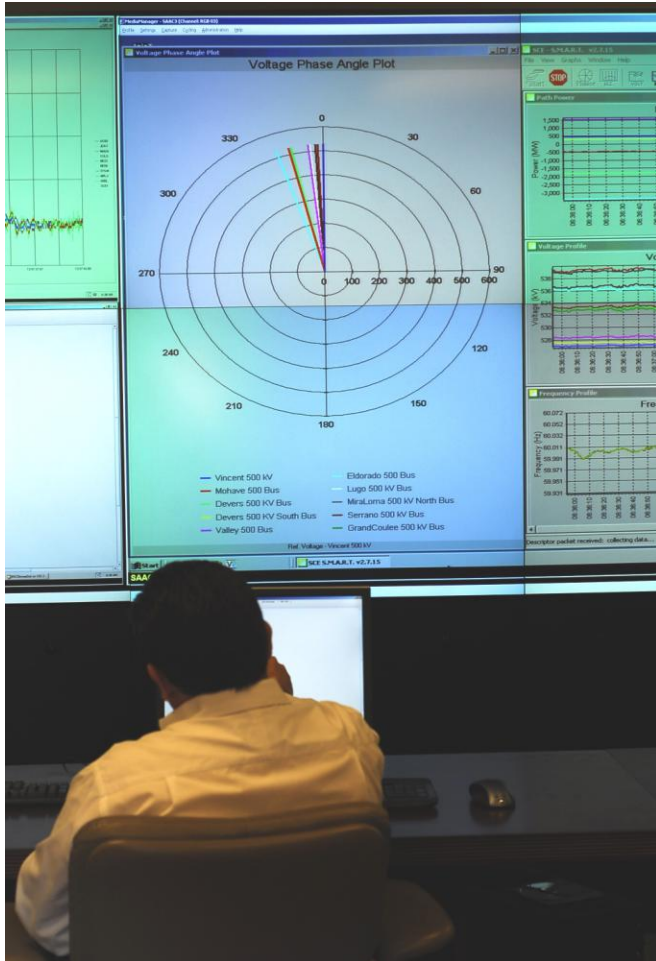
What has SCE Done and What are We Doing to Move Towards a Smarter Transmission Grid?



- Developed a centralized controls system for Reliability Must Run Capacitors
- Phasor Measurement Technologies
 - Installed 21 PMU's and will have 70 installed by the end of 2011
 - Sending PMU data to CAISO
 - Receiving PMU data from BPA
 - Developed Power Systems Outlook software
 - Developed Synchronized Measurement and Analysis in Real Time (SMART) software
 - Developed Syncrophasor operator training
 - Lead several teams on the North American Syncro Phasor Initiative
 - Working on National Standards for Phasors
- Utilizing Phasor data for Static VAR Compensator controls algorithms



What has SCE Done and What are We Doing to Move Towards a Smarter Transmission Grid?



- Created a Situational Awareness and Analysis Center
 - Event reconstruction and model validation
 - Real time monitoring
- Working in conjunction with the WECC modeling task force
 - Need accurate models of intermittent resources and inverter technologies
 - Need accurate models of storage technologies
- CPUC application for renewable integration
- Developed equipment monitoring devices for predictive maintenance
- Utilizing high speed thyristor controlled series capacitors
- Providing technical support for a transmission level high temperature super conducting cables and fault current controller development
- Provided technical support for the advancement of high temperature low sag conductors

What's Next



- Wide Area Controls
 - Static VAR Compensators
 - High Voltage Direct Current Systems
 - Thyristor-controlled series capacitors
 - Flexible Alternating Current Transmission Systems
 - Energy Storage Systems
- Wide Area Monitoring
 - Western Interconnect PMU Data in every Grid Control Center
 - Western Interconnect Situational Awareness
- High temperature superconducting technologies
 - Fault Current Controllers
 - Transformers
 - Conductors

How Can Smart Grid Help Maintain a Reliable Grid?

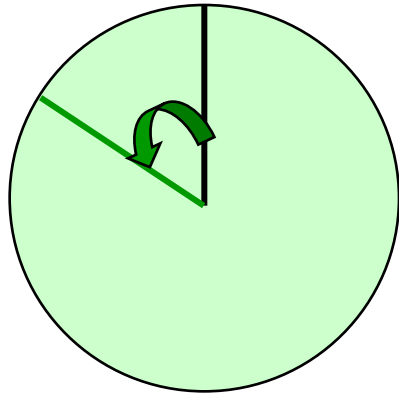


- Will provide wide area visibility
- Will facilitate wide area controls
- Will provide dynamic information for system operations
- Will provide tools to analyze system variables
- Will allow a coordinated integration of intermittent resources.

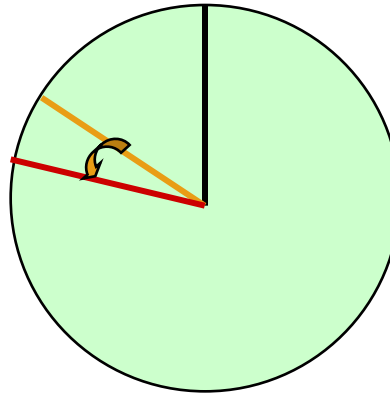
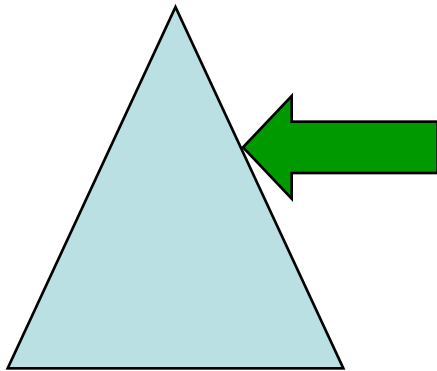
Thank you

Informational Slides

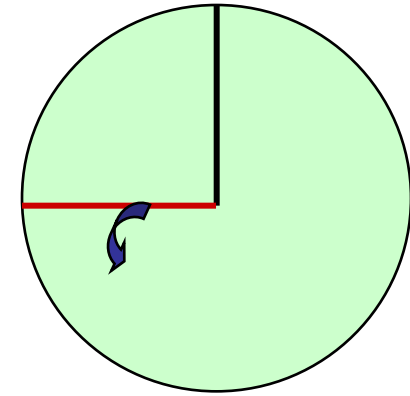
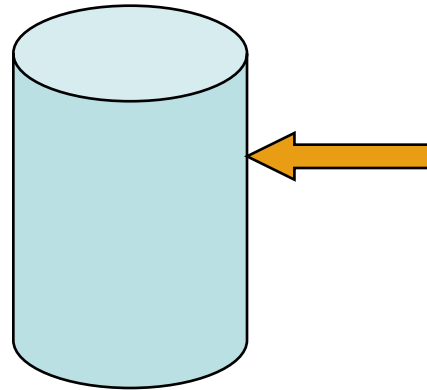
Dynamic Stress Based on System Conditions



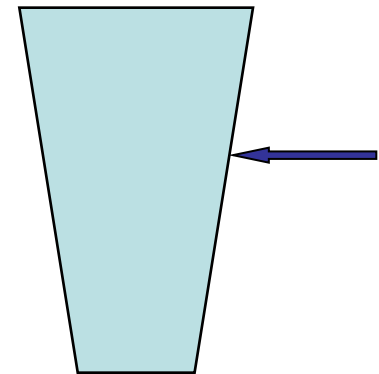
Low stress $< 60^\circ$



Medium $60^\circ - 80^\circ$

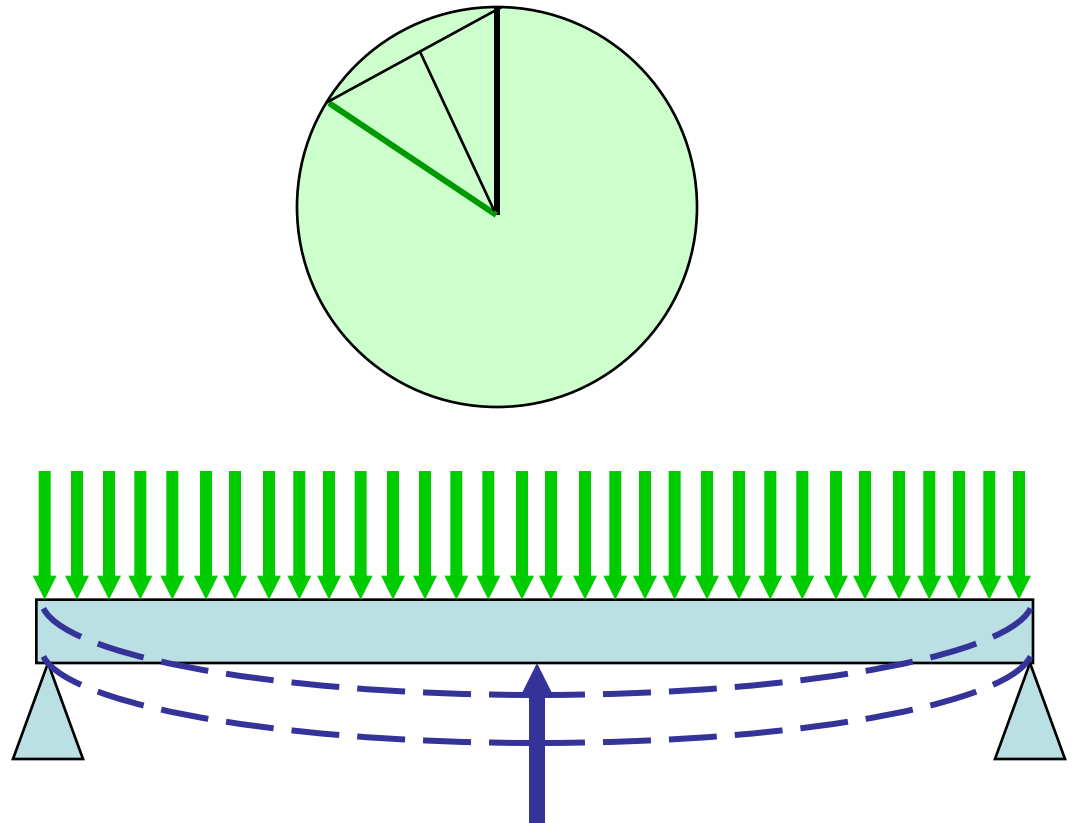
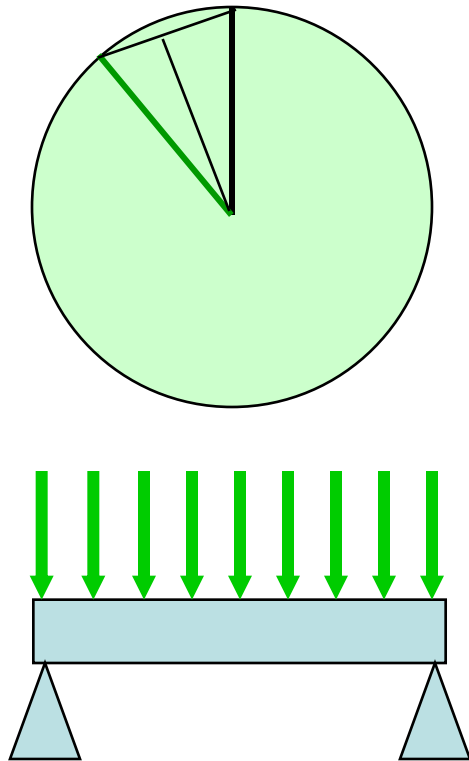


High $> 80^\circ$



Note: Angles shown are valid for WECC system between SCE and BPA

Voltage Support



Support required